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Application Number : 200204963-3

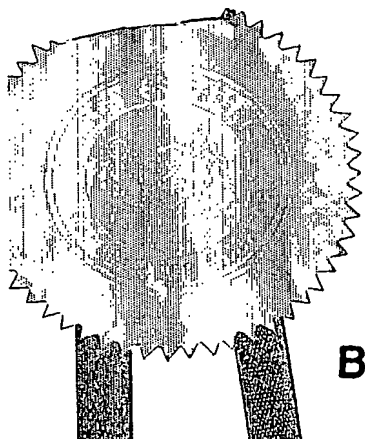
Applicant(s) /  
Proprietor(s) of Patent : SO, KIM LUI

Title of Invention : SELF-CLEANING EXHAUST SYSTEM AND  
METHOD

  
Chig Kam Tack (Mr)  
Senior Assistant Registrar  
for REGISTRAR OF PATENTS  
SINGAPORE

4 Sep 2003

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\*ACTION\*

**PATENTS FORM 1**

Patents Act  
(Cap. 221)  
Patents Rules  
Rule 19

**INTELLECTUAL PROPERTY OFFICE OF SINGAPORE**

**REQUEST FOR THE GRANT OF A PATENT UNDER  
SECTION 25**



101101

\* denotes mandatory fields

**1. YOUR REFERENCE\***

BLUE/1/20201779/KC/mt

**2. TITLE OF  
INVENTION\***

SELF-CLEANING EXHAUST HOOD

**3. DETAILS OF APPLICANT(S)\* (see note 3)**

Number of applicant(s)

1

(A) Name

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State

Country

SG

☐

For corporate applicant

☒

For individual applicant

State of incorporation

State of residency

Country of incorporation

Country of residency

SG

☐

For others (please specify in the box provided below)

(B) Name

Address

State

Country

200204963-3

16 AUG 2002



☐

For corporate applicant

☐

For individual applicant

State of incorporation

State of residency

Country of incorporation

Country of residency

☐

For others (please specify in the box provided below)

(C) Name

Address

State

Country

☐

For corporate applicant

☐

For individual applicant

State of incorporation

State of residency

Country of incorporation

Country of residency

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For others (please specify in the box provided below)

☐

Further applicants are to be indicated on continuation sheet 1

**4. DECLARATION OF PRIORITY (see note 5)**

A. Country/country designated

File number

Filing Date

DD MM YYYY

B. Country/country designated

File number

Filing Date

DD MM YYYY

☐

Further details are to be indicated on continuation sheet 6

**5. INVENTOR(S)\* (see note 6)**

A. The applicant(s) is/are the sole/joint inventor(s)

Yes

☒

No

☐

16 AUG 2002

200204963-3

B. A statement on Patents Form 8 is/will be furnished

Yes

☐

No

☒

6. CLAIMING AN EARLIER FILING DATE UNDER (see note 7)

☐

section 20(3)

☐

section 26(6)

☐

section 47(4)

Patent application number

DD MM YYYY

Filing Date

Please mark with a cross in the relevant checkbox provided below  
(Note: Only one checkbox may be crossed.)

☐

Proceedings under rule 27(1)(a)

DD MM YYYY

Date on which the earlier application was amended

☐

Proceedings under rule 27(1)(b)

7. SECTION 14(4)(C) REQUIREMENTS (see note 8)

Invention has been displayed at an international exhibition. Yes

☐

No

☒

8. SECTION 114 REQUIREMENTS (see note 9)

The invention relates to and/or used a micro-organism deposited for the purposes of disclosure in accordance with section 114 with a depository authority under the Budapest Treaty.

Yes

☐

No

☒

9. CHECKLIST\*

(A) The application consists of the following number of sheets

i. Request

5

Sheets

ii. Description

7

Sheets

iii. Claim(s)

3

Sheets

iv. Drawing(s)

3

Sheets

v. Abstract  
(Note: The figure of the drawing, if any, should accompany the abstract)

1

Sheets

Total number of sheets

19

Sheets

(B) The application as filed is accompanied by:

☐

Priority document(s)

☐

Translation of priority document(s)

☐

Statement of inventorship  
& right to grant

☐

International exhibition certificate

10. DETAILS OF AGENT (see notes 10, 11 and 12)

Name

KEITH CALLINAN

Firm

ALBAN TAY MAHTANI & DE SILVA

11. ADDRESS FOR SERVICE IN SINGAPORE\* (see note 10)

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Level No.

Unit No./PO Box

0643

Street Name

RAFFLES CITY POST OFFICE

Building Name

Postal Code

911722

12. NAME, SIGNATURE AND DECLARATION (WHERE APPROPRIATE) OF APPLICANT OR AGENT\* (see note 12)  
(Note: Please cross the box below where appropriate.)

☒ X

I, the undersigned, do hereby declare that I have been duly authorised to act as representative, for the purposes of this application, on behalf of the applicant(s) named in paragraph 3 herein.

KEITH CALLINAN

Name and Signature

DD MM YYYY

16-08-2002

#### NOTES:

1. This form when completed, should be brought or sent to the Registry of Patents together with the rest of the application. Please note that the filing fee should be furnished within the period prescribed.
2. The relevant checkboxes as indicated in bold should be marked with a cross where applicable.
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  - The address of each individual should also be furnished in the space provided.
  - The checkbox for "For individual applicant" should be marked with a cross.  
Where the applicant is a body corporate
  - Bodies corporate should be designated by their corporate name and country of incorporation and, where appropriate, the state of incorporation within that country should be entered where provided.
  - The address of the body corporate should also be furnished in the space provided.
  - The checkbox for "For corporate applicant" should be marked with a cross.  
Where the applicant is a partnership
  - The details of all partners must be provided. The name of each partner should be indicated in full and the surname or family name should be underlined.
  - The address of each partner should also be furnished in the space provided.
  - The checkbox for "For others" should be marked with a cross and the name and address of the partnership should be indicated in the box provided.
4. In the field for "Country", please refer to the standard list of country codes made available by the Registry of Patents and enter the country code corresponding to the country in question.
5. The declaration of priority in paragraph 4 should state the date of the previous filing, the country in which it was made, and indicate the file number, if available. Where the application relied upon in an International Application or a regional patent application e.g. European patent application, one of the countries designated in that application [being one falling under section 17 of the Patents Act] should be identified and the country should be entered in the space provided.
6. Where the applicant or applicants is/are the sole inventor or the joint inventors, paragraph 5 should be completed by marking with a cross the 'YES' checkbox in the declaration (A) and the 'NO' checkbox in the alternative statement (B). Where this is not the case, the 'NO' checkbox in declaration (A) should be marked with a cross and a statement will be required to be filed on Patents Form 8.
7. When an application is made by virtue of section 20(3), 26(6) or 47(4), the appropriate section should be identified in paragraph 6 and the number of the earlier application or any patent granted thereon identified. Applicants proceeding under section 26(6) should identify which provision in rule 27 they are proceeding under. If the applicants are proceeding under rule 27(1)(a), they should also indicate the date on which the earlier application was amended.
8. Where the applicant wishes an earlier disclosure of the invention by him at an International Exhibition to be disregarded in accordance with section 14(4)(c), then the 'YES' checkbox at paragraph 7 should be marked with a cross. Otherwise, the 'NO' checkbox should be marked with a cross.
9. Where in disclosing the invention the application refers to one or more micro-organisms deposited with a depository authority under the Budapest Treaty, then the 'YES' checkbox at paragraph 8 should be marked with a cross. Otherwise, the 'NO' checkbox should be marked with a cross. Attention is also drawn to the Fourth Schedule of the Patents Rules.
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11. In the event where an individual is appointed as an agent, the sub-field "Name" under "DETAILS OF AGENT" must be completed by entering the full name of the individual. The sub-field "Firm" may be left blank. In the event where a partnership/body corporate is appointed as an agent, the sub-field "Firm" under "DETAILS OF AGENT" must be completed by entering the name of the partnership/body corporate. The sub-field "Name" may be left blank.
12. Attention is drawn to sections 104 and 105 of the Patents Act, rules 90 and 105 of the Patents Rules, and the Patents (Patent Agents) Rules 2001.
13. Applicants resident in Singapore are reminded that if the Registry of Patents considers that an application contains information the publication of which might be prejudicial to the defence of Singapore or the safety of the public, it may prohibit or restrict its publication or communication. Any person resident in Singapore and wishing to apply for patent protection in other countries must first obtain permission from the Singapore Registry of Patents unless they have already applied for a patent for the same invention in Singapore. In the latter case, no application should be made overseas until at least 2 months after the application has been filed in Singapore, and unless no directions had been issued under section 33 by the Registrar or such directions have been revoked. Attention is drawn to sections 33 and 34 of the Patents Act.
14. If the space provided in the patents form is not enough, the additional information should be entered in the relevant continuation sheet. Please note that the continuation sheets need not be filed with the Registry of Patents if they are not used.

Self-Cleaning Exhaust Hood

## Field of the Invention

- 5 The present invention relates to a self-cleaning exhaust hood and refers particularly, though not exclusively, to a self-cleaning exhaust hood for use in domestic and commercial kitchens.

## Background to the Invention

10

- Exhaust hoods are used in many industries to remove polluted air from a work area. This may include the manufacturing and chemical industries. In particular, they are used in kitchens such as commercial kitchens in the food processing industry, and restaurants of all types and categories. In commercial kitchens food is quite often  
15 cooked in oil, or by using oil as a lubricant. The cooking fumes contain oil droplets. Filters in or leading to the flue of the exhaust hood include a stainless steel mesh to capture the majority of oil droplets. Droplets not captured by the filter land on the surface of the exhaust hood, the flue, or are exhausted to atmosphere. When the oil droplets cool and start to dry they become very sticky, and are hard to remove. Also,  
20 the filters have a fairly open mesh as they can become clogged (and thus become ineffective) very quickly. The exhaust hood can also be quickly lined with the cooled and dried oil, as can be the flue. This leads to many problems: a rapid build-up of bacteria in the cooled and dried oil – a major problem in a commercial kitchen; and increased fire risk from the oil; ineffective exhaust operation leading to greater  
25 workplace health and safety issues; and increased pollution of the atmosphere.

Cleaning exhaust hoods and the filters manually is time-consuming, tedious, and labour intensive task.

- 30 There have been many proposals for self-cleaning using water curtains, water baths, or sprays. Most have the problem that they cannot be operated during cooking process – when the oil is most fluid and therefore more easily removed. Most do not improve the elimination of oil from the exhaust air to atmosphere.

- 35 It is therefore the principal object of the present invention to provide a self-cleaning exhaust hood wherein the self-cleaning system can be operated during the cooking process.

A further object of the present invention is to provide a self-cleaning exhaust hood where a filter can be continuously cleaned.

- 5 Another object of the present invention is to provide a self-cleaning exhaust hood where a smaller mesh filter can be used.

#### Summary of the Invention

- 10 With the above and other objects in mind, the present invention provides a self-cleaning exhaust hood including a first filter in air flow path, a first spray means located in said air flow path before said first filter for providing a first cleaning spray onto a first surface of said first filter, and a second spray means located in said air flow path after said first filter for providing a second cleaning sprays onto a second surface  
15 of said first filter. There may be provided a second filter in said airflow path after said first filter, and the second filter may be substantially identical to the first filter.

The first spray means may be at least one nozzle, and the second spray means is at least one nozzle.

20

- The self-cleaning exhaust hood may have a top, a front wall, a rear wall, and sidewalls extending between the rear wall and the front wall. There may also be a baffle depending from the top intermediate the front wall and the rear wall. Both the first and second filters may be mountable to the rear wall and the baffle to extend  
25 therebetween. There may also be a plate extending forwardly from the rear wall forwardly of the baffle.

- The plate may have an upwardly directed projection extending between the baffle and the front wall, the projection extending upwardly to a height at least as high as the  
30 mounting of the first filter to the baffle.

The first spray means may be mounted on the plate, and the second nozzle mounted on the rear wall.

- 35 The first filter may inclined with respect to the air flow path, and cover the air flow path; and the second filter may be inclined with respect to the air flow path, and cover the



air flow path. The first filter may be at an angle of inclination to the air flow path substantially the same as that of the second filter.

5 The self-cleaning exhaust hood may include a tank for containing a cleaning liquid for the cleaning sprays. The cleaning liquid may include a degreaser and the first cleaning spray may have droplets of a size to combine with droplets of contaminants to assist the combined droplets being captured by the first filter.

10 An another form, the present invention provides a self-cleaning exhaust hood including a first filtering means for filtering contaminants from an air flow along on air flow path, a first spray means for providing a first spray of a cleaning liquid onto the first filtering means, and means for preventing the first spray from moving against the air flow.

15 The means for preventing may include a plate mounted below the first filtering means and an upwards projection at a forward end of the plate.

#### Description of the Drawings

20 In order that the invention can be readily understood and put into practical effect, there shall now be described by way of non-limitative example only a preferred embodiment of the present invention, the description being with reference to the accompanying illustrative drawings in which:

25 Figure 1 is a schematic view of the operation of the self-cleaning system of the present invention;

Figure 2 is a vertical cross-sectional view of a self-cleaning exhaust hood according to a first embodiment of the present invention; and

30 Figure 3 is a schematic representation of a preferred form of the tank system.

#### Description of the Preferred Embodiments

35 To first refer to Figure 1, there is shown an airflow path defined by an airflow path 10 through which air flows in the direction of arrow 12.

Mounted in path 10 is a first filter 14 for filtering contaminants, particularly oil droplets, from the air flowing through path 10. The filter should substantially completely block path 10 so only minimal air in airflow 12 does not pass through first filter 14.

- 5    Located behind first filter 14 is a second filter 16 preferably substantially the same as first filter 14, so as to allow for inter-changeability. Its mesh size may be the same as first filter 14, or may be smaller. As the majority of the oil droplets will be removed by first filter 14, second filter 16 may have a smaller mesh size as the risk of clogging is significantly reduced.

10

- Operatively connected to path 10 is a cleaning solution basin or tank 18. The tank 18 may be attached to path 10, as shown, or may be separate from path 10. If separate, appropriate connections such as by hoses, tubes, pipes, manifolds, and so forth will need to be provided. Access openings 20, 22, 24 and 26 are provided from path 10  
15    into tank 18. There may be direct openings or may represent hoses, tubes, pipes, manifolds, and so forth.

- Located in or adjacent tank 18 is a pump 28 for supplying a cleaning solution 26 through pipes, tubes or hoses 30 to a first nozzle 32 mounted in front of first filter 14.  
20    Nozzle 32 may be a single nozzle, a plurality of nozzles in an array, an outlet manifold with a plurality of holes (as in a shower rose), or the like. The purpose of nozzle 32 is to provide a spray 40 of a cleaning solution 36 onto substantially the complete front surface 38 of first filter 14. The nozzle 32 "atomizes" the cleaning solution 36 to form a fine spray 40, preferably a very fine spray 40. The spray 40 should have a droplet  
25    size such that it will be carried by airflow 12 onto surface 38 and into filter 14 to thus clean surface 38 and filter 14. However, the pressure applied by pump 28 is preferably not so great that spray 40 will be reflected by surface 39 with such force that it will be flow against air flow 12 and thus risk passing along air path to the cooking area. By having filters 14, 16 angled, any reflected spray will tend to be  
30    directed in a manner as to be captured by airflow 12.

- Preferably, the cleaning solution is a mixture of water and a degreaser in a required ratio. The ratio may be any suitable ratio depending on the degreaser used, and the oil used during the cooking process. Preferably the ratio is in the range of 1:10 to  
35    1:50; more preferably 1:20.

In this way the filter is cleaned by spray 40. The spray 40 will also combine with the oil droplets in the airflow 12 to form larger droplets. The larger droplets will more likely be captured by first filter 14. Also, as the oil droplets are still more fluid as they have not yet cooled, they will be acted on by the degreaser in the cleaning solution 36 of spray 40, and will thus flow under the influence of gravity to the bottom of path 10, and flow through opening 20 back into tank 18. In this way the cleaning solution 36 can be recycled.

A second nozzle 34 supplied by pipe or hose 46, is provided behind first filter 14 to spray cleaning 36 solution on to rear surface 42 of first filter 14. The second nozzle 34 may be the same as first nozzle 32, or maybe different. It should provide a spray 44 over substantially all of rear surface 42 to further assist in cleaning first filter 14. As the spray 44 is against air flow 12, the pressure from pump 28 may be higher to nozzle 34 than for first nozzle 32 if desired. Any spray 44 together with captured oil will drain down filter 14 and surface 42 and pass through opening 22 into tank 18. Any spray 44 reflected off surface 42 will be carried by air flow 12 to second filter 16 thus preventing undesired food contamination. Pump 28 may be in the same circuit as the fan (not shown) for the airflow 12 so no spraying of cleaning solution will take place unless there is airflow 12. In this way the cleaning solution cannot flow to the cooking area. However, pump 28 should be able to be independently switched off, if desired.

By having filters 14, 16 continuously cleaned during the cooking operation, clogging is less likely and thus smaller mesh sizes may be used in filters 14, 16 to thus increase the effectiveness of their operation.

25

To refer to Figure 2, like components use like reference numerals with the addition of a prefix number "2". Here, there is shown an exhaust hood 250 with an exhaust flue 252. Hood 250 has a front wall 254, top 256, sides 258 and rear 260. An air flow path 210 is partly defined by front 254, and an internal baffle 262 depending from top 256 for the operative width of hood 250. Removably mounted to baffle 262 and rear 260 are first filter 214 and second filter 216. Mounted below first filter 214 and extending forwardly from rear 260 is a plate 264, again extending for the full operative width of hood 250. Plate 264 forms a further part of air path 210. Plate 264 extends forwardly to a position intermediate the planes of baffle 262 and front wall 254.

35

Plate 264 may have an end projection 266 extending upwardly from front end 268 of plate 264. Projection 266 extends for the full operative width of hood 250. Projection

266 preferably extends upwardly to at least where first filter 214 is attached to baffle 262. Projection 266 is also preferably located approximately mid-way between front wall 254 and baffle 262.

- 5 Air flow path 210 is therefore somewhat "S" shaped in that it passes between front 254 and projection 266, over projection 266, between projection 266 and baffle 262, between plate 264 and first filter 214, then through first filter 214 and second filter 216.

10 Mounted on plate 264 is first nozzle(s) 232 for directing the spray 240 onto first filter 214. Second nozzle is mounted on rear wall 260 for directing spray 244 onto first filter 214. In this instance, tank 18 is split between a first tank 218a and a second tank 218b, connected by a pipe 270. Pipes/tubes 230 and 246 operate as normal.

15 Spray 240 will not "escape" from hood 250 due to plate 264 and projection 266 and/or due to airflow 212. Therefore, the spray system can operate when cooking is taking place beneath plate 264.

To now refer to Figure 3, there is shown a preferred form of tank system. Here like components have like reference numerals with the addition of a prefix number "3".

20

The tank 318 is for holding the cleaning solution 336. The cleaning solution is supplied to nozzles 332, 334 (not shown) by the pump 328 through pipe 330 and pipe 346 (shown as one pipe). A supply pipe 372 with a filter 374 at its end inside tank 318 supplies the cleaning solution to the pump 328. The pump 328 preferably has an interlock so that when the exhaust fan is operating, the pump 328 will be operating. The pump 328 may also have a manual or cleaning mode so it can be operated independently of the exhaust fan to assist in the cleaning of the exhaust hood, flue, and so forth. This would normally be after cooking has been completed so there is no risk of contamination.

30

A return pipe or hose 376 is provided to return the cleaning solution to tank 318. An outlet pipe 378 is operatively connected to tank 318 and has a valve 380. Valve 380 may be motorized, or manual. Valve 380 is operated from time-to-time to drain the tank 318 to allow the replacement of the cleaning solution 336. This may be, for example, daily, every 10 hours of operation, or as required. If the valve 380 is motorized, it may have a controller and/or timer to operate when required on an operator-determined cycle.

35

An inlet pipe 382 is provided and which is connected to a water supply to enable water to be added to the tank 318 when required. A ball valve 384 in pipe 382 is used to control the amount of water added to tank 318. An overflow warning device 386 may  
5 also be provided. This may be operatively connected to valve 384, if desired.

A master on/off valve 388 may also be provided in pipe 382 before ball valve 384. Again, valve 388 may be manual, or motorized. If motorized, valve 388 may be linked to valve 380 so that if valve 380 is closed, valve 388 is open; and if valve 380 is open,  
10 valve 388 is closed. Only one of valves 380, 388 may be open at the one time.

The degreaser is stored in a chemical tank 390 that is connected to pipe 382 between ball valve 384 and a non-return valve 392 by a chemical pipe 396. The non-return valve 392 is to prevent cleaning solution 336 flowing up pipe 382. Chemical tank 390  
15 may have a ball valve 394 so that a bulk supply (not shown) can be used to top-up the degreaser in chemical tank 390.

Preferably, the chemical pipe 396 is connected to pipe 382 such that the water flow in pipe 382 acts like a venturi pump to draw in the degreaser at a required rate. By  
20 having chemical pipe 396 after ball valve 384 and before non-return valve 392, any degreaser entering pipe 382 does so into a flow of water and is therefore instantly diluted. Non-return valve 392 may be pressure activated so that when ball valve 384 closes, there will be no pressure on non-return valve 392, so it will also close. This will leave residual water in pipe 382 between valves 384 and 386 to dilute any  
25 degreaser. This prevents excessive corrosion of the seat of valves 384 and/or 386.

Whilst there has been described in the foregoing description preferred embodiments of the present invention, it will be understood by those skilled in the technologies concerned that variations in details of design or construction may be made without  
30 departing from the present invention.

The present invention extends to all features disclosed either individually, or in all possible combinations and permutations.

## The claims:

1. A self-cleaning exhaust hood including a first filter in air flow path, a first spray means located in said air flow path before said first filter for providing a first cleaning spray onto a first surface of said first filter, and a second spray means located in said air flow path after said first filter for providing a second cleaning sprays onto a rear surface of said first filter.
2. A self-cleaning exhaust hood as claimed in claim 1, wherein there is provided a second filter in said airflow path after said first filter.
3. A self-cleaning exhaust hood as claimed in claim 2, wherein the second filter is substantially identical to the first filter.
4. A self-cleaning exhaust hood as claimed in any one of claims 1 to 3 wherein the first spray means is at least one nozzle.
5. A self-cleaning exhaust hood as claimed in any one of claims 1 to 4, wherein the second spray means is at least one nozzle.
6. A self-cleaning exhaust hood as claimed in any one of claims 1 to 5, including a top, a front wall, a rear wall, and side walls extending between the rear wall and the front wall; there being provided a baffle depending from the top intermediate the front wall and the rear wall.
7. A self-cleaning exhaust hood as claimed in claim 6, wherein both the first and second filters are mountable to the rear wall and the baffle to extend therebetween.
8. A self-cleaning exhaust hood as claimed in claim 5 or claim 7, including a plate extending forwardly from the rear wall forwardly of the baffle.
9. A self-cleaning exhaust hood as claimed in claim 8, wherein the plate has an upwardly directed projection extending between the baffle and the front wall.

10. A self-cleaning exhaust hood as claimed in claim 9, wherein the projection extends upwardly to a height at least as high as the mounting of the first filter to the baffle.
- 5 11. A self-cleaning exhaust hood as claimed in any one of claims 8 to 10, wherein the first spray means is mounted on the plate.
12. A self-cleaning exhaust hood as claimed in any one of claims 6 to 11, wherein the second nozzle is mounted on the rear wall.
- 10 13. A self-cleaning exhaust hood as claimed in any one of claims 1 to 12, wherein the first filter is inclined with respect to the air flow path, and covers the air flow path.
- 15 14. A self-cleaning exhaust hood as claimed in claim 2 or any one of claims 3 to 13 when appended to claim 2, wherein the second filter is inclined with respect to the air flow path, and covers the air flow path.
- 20 15. A self-cleaning exhaust hood as claimed in claim 14 when appended to claim 13, wherein the first filter is at an angle of inclination to the air flow path substantially the same as that of the second filter.
16. A self-cleaning exhaust hood as claimed in any one of claims 1 to 15, further including a tank for containing a cleaning liquid for the cleaning sprays.
- 25 17. A self-cleaning exhaust hood as claimed in claim 16, wherein the cleaning liquid includes a degreaser.
- 30 18. A self-cleaning exhaust hood as claimed in any one of claims 1 to 17, wherein the first cleaning spray has droplets of a size to combine with droplets of contaminants to assist the combined droplets being captured by the first filter.
- 35 19. A self-cleaning exhaust hood including a first filtering means for filtering contaminants from an air flow along on air flow path, a first spray means for providing a first spray of a cleaning liquid onto the first filtering means, and means for preventing the first spray from moving against the air flow.

20. A self-cleaning exhaust hood as claimed in claim 19, wherein said means for preventing included a plate mounted below the first filtering means and an upwards projection at a forward end of the plate.



**Abstract****Self-Cleaning Exhaust Hood**

- 5 A self-cleaning exhaust hood including a top, a front wall, a rear wall, and side walls  
extending between the rear wall and the front wall; there being provided a baffle  
depending from the top intermediate the front wall and the rear wall; and a plate  
extending forwardly from the rear wall to forwardly of the baffle; there being included a  
10 first filter in air flow path, a first spray means located in said air flow path before said  
first filter for providing a first cleaning spray onto a first surface of said first filter, a  
second spray means located in said air flow path after said first filter for providing a  
second cleaning sprays onto a rear surface of said first filter there being a second filter  
in said air flow path after said first filter.

- 15 Figure 2

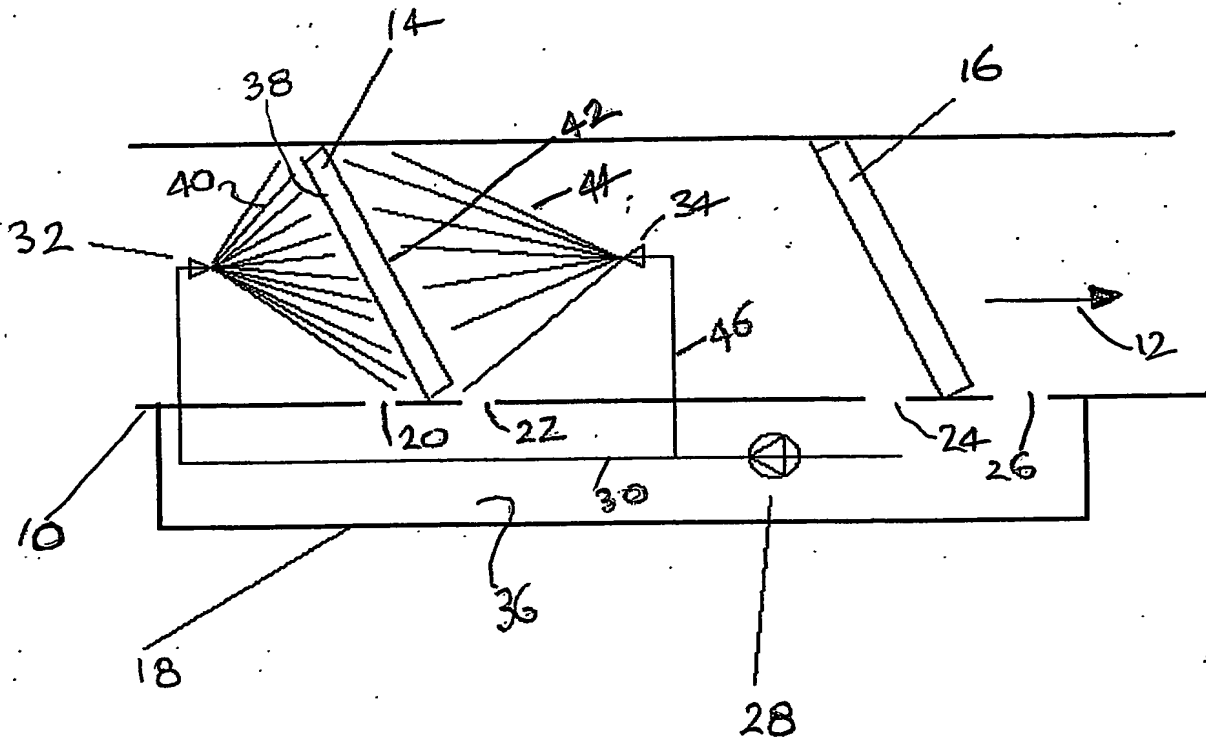


Figure 1

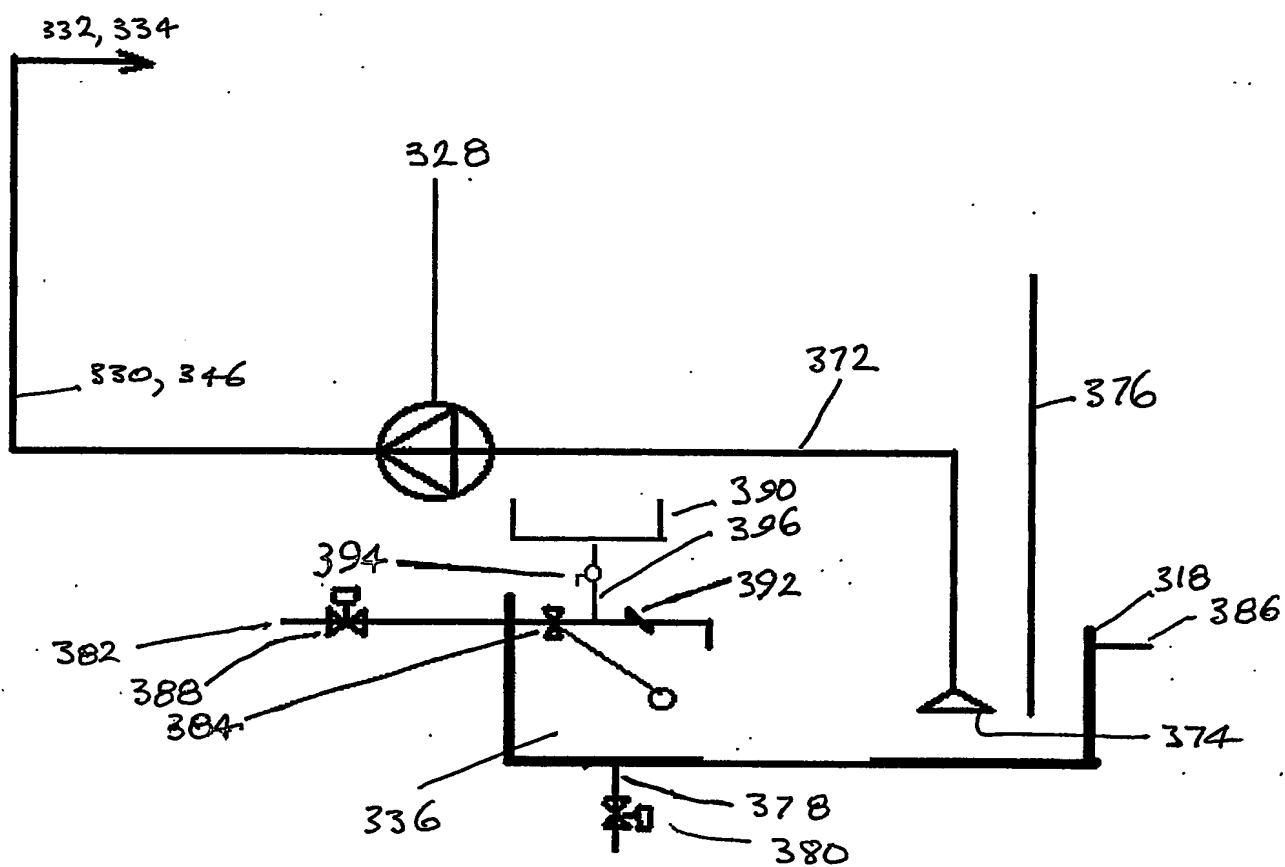


Figure 3

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